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**OBSERVATIONS MADE IN 1907 ON GLACIERS IN ALBERTA AND
BRITISH COLUMBIA**

BY GEORGE, JR., AND WILLIAM S. VAUX.

But few vital changes are to be noted from year to year in the glaciers of these regions, and yet a careful observation of what is taking place may in time throw some additional light on the problems of glacier action which as yet remain unsolved. This can be our only apology for again presenting to the Academy of Natural Sciences of Philadelphia the results of the work done on the several glaciers in Alberta and British Columbia in August, 1907, which is a continuation of that first begun on the Illecillewaet Glacier twenty years ago.

As a preliminary it may be stated that the winter and early spring of 1907 were cold and backward. Immense banks of snow collected in the valleys and even covered the glacier tongues till the spring was fully opened; snow fell much later than usual at normal elevations, and much larger banks were noted on the mountainsides than for many years. Rain and a deficiency of sunlight retarded melting, so that much more snow remained in the fall, both in the valleys and the higher slopes, and it is probable that many snowbanks had not entirely disappeared before the winter falls set in.

ILLECILLEWAET GLACIER.

GLACIER HOUSE, BRITISH COLUMBIA.

Recession.—With the above conditions in mind, it is interesting to note that on August 12, 1907, the tongue of ice of the Illecillewaet Glacier was 382 feet above the marked rock "C," which has been the datum point since August 17, 1898, or a recession of fifty-five feet since July 24, 1906. The above measurement was made from the datum rock to the ice along a line parallel with the axis of the glacier.

Measurements made to the nearest ice farther to the east of this line, which was established several years ago, would doubtless show a much smaller recession, but it would seem that in fairness the measurement points should be kept as nearly as possible in the same straight line from year to year. It, however, appears to be a fact that the tongue or point of greatest extension of this glacier lies many feet to the east of the position of ten years ago.

Test Picture.—The annual test picture was taken from Rock W, on August 19, 1907, and shows a continued shrinkage on both sides and in depth of the tongue. This last feature is particularly marked when walking over the slopes of ice on a line with the test plates. When the location for these was selected it was largely on account of the even slope and uncrevassed surfaces. Now great crevasses are found, but particularly on the left side, and the slope in places approximates 35 degrees, whereas ten years ago it was but 22 degrees. A careful study of the rock at the sides of the ice stream and the probable form of the bed on which the glacier flows would indicate that the tongue has now almost reached the upper edge of the nearly flat bed moraine which has been gradually uncovered for at least twenty years, and should recession continue the ice edge will begin to mount over ledges of bed rock which have been worn and polished for ages beneath the glacier mass.

Flow of the Glacier above the Tongue.—The six steel plates laid out on July 12, 1906, were located again on August 12, 1907, after a period of exactly thirteen months or 396 days. After a good deal of difficulty they were all found, but it was not possible to triangulate the position of No. 6 on the extreme left of the glacier, which had taken a position on a blade of ice between two very deep crevasses, and so far below the general level of the glacier that a tower forty feet high would have been required to bring the stadia within the field of view of the transit.

The following table gives the total motion of the five plates during the interval of thirteen months, and the average daily motion computed from this total. In the last column has been repeated the observed daily motion of these plates laid out on July 12, 1906, and located again twelve days later.¹

Motion of 1906 Plates on Surface of Illecillewaet Glacier, July 12, 1906, to August 12, 1907.

Number of Plate.	Total motion 396-day interval (inches).	Average daily motion 396-day interval (inches).	Average daily motion twelve-day interval summer of 1906 (inches).
1	960	2.45	Plate lost.
2	1,056	2.67	7.00
3	2,136	5.39	11.33
4	2,664	6.73	9.75
5	2,436	6.15	10.25
6			8.85

¹ Compare "Observations made in 1906," *Proc. Acad. Nat. Sci. Phila.*, December, 1906, pp. 573, 574.

ASULKAN GLACIER.

GLACIER HOUSE, BRITISH COLUMBIA.

Changes in Tongue.—The same record of breaking down and recession must be made of this glacier, and indeed the changes noted are more marked than for several years. The right side is melting rapidly, with the result that the stream of ice is becoming narrower. On the left side there is not so much change, owing to the mantle of moraine which retards melting. There is much less ice at the tongue than last year and recession is marked. The general surface of the ice is rougher and there are many crevasses at the line of plates where last year even slopes were found. The large rock marked in 1899 was found to rest in its original position, though heaped all around with fresh moraine. The distance from this rock on August 15, 1907, to the thin tongue of ice was found to be 54 feet 6 inches, showing that amount of recession since last year.²

The Flow of Glacier above Tongue.—On August 15, 1907, the position of the plates laid out on July 13, 1906, was determined, giving the motion of the ice for a period of about thirteen months or 398 days. The results are given in the following table, to which have been added the data obtained in 1906 of the rate of summer motion of the same plates, covering a ten-day interval.

Motion of 1906 Plates on Surface of Asulkan Glacier, July 13, 1906, to August 15, 1907.

Number of Plate.	Total motion 398-day interval (inches).	Average daily motion 398-day interval (inches).	Average daily motion ten-day interval summer of 1906 (inches).
7	Lost.	—	2.40
8	449	1.13	3.90
9	Lost.	—	5.50
10	1,147	2.88	6.70
11	1,231	3.10	6.70
12	1,245	3.13	6.30
Boulder.	—	—	8.90

VICTORIA GLACIER.

LAKE LOUISE, ALBERTA, CANADA.

This glacier was visited on August 8, 1907, during a long period of

² Compare "Observations made in 1906," *Proc. Acad. Nat. Sci. Phila.*, December, 1906, p. 575.

storm. The changes, though not marked, are all in the line of shrinkage and recession. The tongue, still buried in moraine, is not different from previous years, but the steep slopes of ice on the left side are gradually retreating and depositing masses of bowlders on the ground moraine below. The large angular blocks which fell from the ice in 1899 are now 126 feet from the edge of ice, which indicates a further retreat of fifty-two feet since July 30, 1906. The large boulder on the ice surface has moved many feet down with the ice, but owing to the bad weather and dense fog which obscured the line points it was not possible to determine the changes with any accuracy.

YOHO GLACIER.

YOHO VALLEY, FIELD, BRITISH COLUMBIA.

This glacier was visited on August 19, 1907. It has receded very appreciably the past year, particularly on the left side, where many acres of *roches moutonné* have been left bare or covered with masses of moraine. Some of these are glaciated and graved most beautifully, and many small spherical quartzite pebbles about the size of marbles and quite as true were found in pockets where they had been deposited.

The right side of the glacier does not appear to have changed so greatly, probably owing to the form of glacier bed and the increased pressure of ice on this side.

As with other examples in this region, the point of greatest extension of the glacier is a very long blade-like tongue extending in one of the trough-like grooves parallel with the axis of the glacier. Measuring from the bed rock marked on August 17, 1901, to this ice the distance was found to be 147 feet 4 inches, or a recession of 70 feet for the year. If, however, the line is taken in the same direction as previous years the distance was 423 feet, or 346.3 feet recession. This is the greatest change which has been noted in any glacier in this region since observations were recorded.

As a conclusion it may be noted that the yearly average flow of the ice streams continues about as in previous years, but the recession of the tongues, shrinkage and breaking down is increasingly marked. The Asulkan Glacier, which for several years was stationary or slightly advancing, has this year showed marked retreat and shrinkage, and the same is the case with the Victoria Glacier. Preceded by a cold and stormy winter and a summer with low average of sunshine and low temperature, these conditions point to an interesting series of changes which may ultimately throw some light on the relation between weather conditions and glacier change.